THE JEWELED SHOOTING STAR (DODECATHEON AMETHYSTINUM): A POST GLACIAL MIGRANT IN THE MISSISSIPPI VALLEY

Donald Ugent,[1] Michael Verdun[2] and Michael Mibb[3]

Department of Botany, Southern Illinois University,
Carbondale, IL 62901

Fassett (1944), in his monograph of the genus *Dodecatheon* in eastern North America, discusses the probable origin and past distribution of his jeweled shooting star, *D. amethystinum*, a plant which he first described (1929) as a variety of *D. meadia* L., but then later (1931) renamed as a species. At the time of Fassett's monograph, the only known collections of this shooting star were from the following three places: 1) bluff tops along the Mississippi River in the "Driftless Area" of the upper midwest (i.e. southwestern Wisconsin, northwestern Illinois and the valleys of the adjoining states); 2) cliff tops at Hannibal, Missouri; and, 3) scattered, isolated bluff tops in W. Virginia, Ohio and Pennsylvania, the latter stations all located south of the glacial line.

Fassett, who was a former student of the well known Harvard botanist M.L. Fernald and an advocate of his published (1925) theory on the "persistence of plants in unglaciated areas of Boreal America," attached special significance to the occurrence of the jeweled shooting star in the "Driftless Area" of the upper midwest. Because the known distribution of *D. amethystinum* in 1944 appeared to be similar in pattern and extent to some of the relic species of the driftless area which Fernald had earlier written about, Fassett concluded the plant had probably a similar history. Thus, he writes ". . . This appears to be one of those species which had a fairly general range northeastward before the Pleistocene glaciations, whose occurrence is now limited to localities which escaped glaciation."

Fassett's basic premise, the relic origin of *D. amethystinum*, while based in part on the known habitat preferences of this species, was arrived at only after an intensive study of herbarium distribution records. The latter being far from complete, however, falsely suggested to that author that he was dealing with a major plant disjunction.

[1] Professor of Botany
[2] Project Associate
[3] Assistant Curator of the Herbarium

Today, a number of new bluff top localities for *D. amethystinum* have been recorded for Illinois, these situated in glaciated as well as driftless areas of the state. Since the range of this species now appears to be nearly continuous along the Mississippi River in this portion of the upper midwest, a reinterpretation of the plant's history is suggested. The following account then, is intended as a partial fulfillment of that aim.

TAXONOMIC TREATMENT

Following the publication of Fassett's initial set of works on this plant (1927, 1929 and 1931), it was subsequently upheld as a species by Steyermark (1940, 1963), Wherry(1943), Fassett (1944), Fernald (1950), Jones (1950), Strausbaugh and Core (1958), Iltis and Shaughnessy (1960), and Mohlenbrock (1978).

Thompson (1953), however, reduced *D. amethystinum* to synonymy under *D. radicatum* Greene. This treatment of *D. amethystinum*, while not agreed to here, is seen to follow most logically when greater emphasis is placed on the relative thickness of the capsule wall as a taxonomic character than on the presence or absence of a filament tube. However, capsule wall thickness in this species complex does not appear to be correlated with any other previously studied character, whereas the degree of union of the filaments appears to be associated with the length/width ratio of the leaves, the latter clearly illustrated by the scatter-diagram analysis of Iltis and Shaughnessy (1960).

When the non-united filaments and broad leaves of *D. amethystinum* are taken into consideration, the plant appears to be more closely related to *D. meadia* than to *D. radicatum*. This interpretation also appears to conform best with the known geographic facts. Thus, the distribution of this species is fully included within the range of *D. meadia*, whereas the distribution of *D. radicatum* (excluding *D. amethystinum*; see Thompson, 1953) is completely separate and wholly western.

D. amethystinum differs from *D. meadia* in having linear-oblong, thin walled capsules and bluish-green leaves, the latter rarely marked with a basal red spot. The papery capsules of this species have yellowish-brown walls, these measuring from 35 to 120 microns in thickness. As previously noted by Fassett (1944), the walls are easily split by pressure from a pencil. *D. meadia*, on the other hand, has firm, reddish-brown, ovoid capsules, the walls of which vary in thickness from 135 to 325 microns (Fig. 1).

One final difference between the last two species lies in the degree of solubility of the reddish pigments contained in their leaves. Thus, Fassett (1944) notes that the leaf pigmentation of D. meadia is little affected by the immersion of the leaf blade in boiling water for up to three hours duration; whereas, in D. amethystinum, the coloration soon exits from the leaves.

ECOLOGICAL CONSIDERATIONS

D. amethystinum is found throughout its range on moist, shaded river bluffs. West of Cave Springs Hollow in Calhoun County, Illinois, where this species was recently discovered by the authors, it was found on north and west facing limestone ledges some 200 meters distant from the Mississippi River. Here, some of the plants grew on a thin cap of overlying soil no more than 2 cm thick in places. Subsequent lab tests showed this soil to be rich in organic matter and very slightly acidulous, with a pH of about 6.9.

Plants found growing in close association with D. amethystinum at this locality include the walking fern (Camptosorus rhizophyllus), blunt-lobed woodsia (Woodsia obtusa), and slender lip fern (Cheilanthes feei). In the crevices of the rock face itself were tall alumroot (Heuchera americana var. hirsuticaulis) and hydrangia (Hydrangia arborescens). Found on the steep wooded slopes immediately below the rock ledges were jack-in the-pulpit (Arisaema atrorubens), false rue anemone (Isopyrum biternatum), yellow fumewort (Corydalis flavula), terrell grass (Elymus virginicus), Missouri gooseberry (Ribes missouriensis), spiderwort (Tradescantia subaspera), jewelweed (Impatiens sp.), and wooly blue violet (Viola sororia). Woody species of the area included shagbark hickory (Carya ovata), musclewood (Carpinus caroliniana), flowering dogwood (Cornus florida), sycamore (Platanus occidentalis), prairie rose (Rosa setigera), basswood (Tilia americana), sugar maple (Acer saccharum), and silver maple (Acer saccharinum).

Although the Cave Springs Hollow locality lies in non-glaciated territory, the jeweled shooting star is also known from the nearby glaciated counties of Pike, Greene, and Jersey, as well as the west-central Illinois county of Fulton (Mohlenbrock, 1978). It is also known from the vicinity of Hannibal, Missouri, which according to geologists, was another area once covered by Pleistocene ice.

According to Steyermark (1940), D. amethystinum is found at the Hannibal location on limestone ledges along the bluffs of the Mississippi River. Here, it grows in close association with two northern plants, red-berried elder (*Sambucus pubens*) and wild sarsaparilla (*Aralia nudicaulis*), as well as with many plants of Ozarkian origin.

In Wisconsin, according to Iltis and Shaughnessy (1960), the plant is restricted to the cliffs and high bluffs of the Mississippi River. They report it grows on damp and mossy rock outcrops; on earth slopes in cool woods; on north facing bluffs; and, in deep ravines. It is also reported from cliffs of Ordovician limestone, as well as from the edges of open woods and small upland prairies.

Habitat information for this plant at Wyalusing State Park in Grant County, Wisconsin is especially complete. On some bluff tops within the park, according to Iltis and Shaughnessy (1960), the jeweled shooting star is associated mainly with the walking fern (*Camptosorus rhizophyllus*) and the endemic goldenrod of the driftless area (*Solidago sciaphila*); whereas in other, more heavily forested areas of the park it is found with the acute-lobed hepatica (*Hepatica acutiloba*), wild columbine (*Aquilegia canadensis*), flexuous-stemmed goldenrod (*Solidago flexicaulis*), miterwort (*Mitella diphylla*), heart-leaved aster (*Aster cordifolius*), bladder-fern (*Cystopteris bulbifera*), wild sarsaparilla (*Aralia nudicaulis*), Solomon's-seal (*Polygonatum canaliculatum*), spring beauty (*Claytonia virginica*) and Virginia-creeper (*Parthenocissus vitacea*). Dominant tree species at Wyalusing include sugar maple (*Acer saccharum*), basswood (*Tilia americana*) and paper birch (*Betula papyrifera*).

Iltis and Shaughnessy also report that soil samples taken from areas within Wyalusing State Park where *D. amethystinum* grows are mostly slightly acid. These range from pH 6.3 to 6.9. However, one sample was described as slightly alkaline (pH 7.4).

CONCLUSIONS

The known range of *D. amethystinum* in Illinois is considerably extended by collections cited here and by Mohlenbrock (1978). This plant now appears to be nearly continuous in distribution along the bluff tops of the Mississippi River from Calhoun County in central Illinois to Buffalo County in central Wisconsin. In addition, this species has a single station along the Illinois River in Fulton County, and appears to be equally at home in both glaciated and non-glaciated areas.

If one takes into account the above extended geographic data, the pattern of distribution of D. amethystinum in Illinois and Wisconsin would no longer appear to conform to the basic tenets of the 1925 Fernaldian theory on the "persistence of plants in unglaciated areas of Boreal America". No major disjunction in the range of this plant in the northern sector of its area of occurrence is apparent. Thus, far from representing a pre-glacial relic within the driftless area of the upper midwest, as proposed originally by Fassett (1931, 1944), this species would appear instead to be a post-glacial migrant to the southern Wisconsin area.

The above hypothesis is supported in part by the known post-Pleistocene changes in the climate and vegetation of the upper midwest. It has been reported by Dolf (1960), Spurr (1964) and others, for example, that a very warm and moist period, beginning about 2000 years ago and extending to about 1300 A.D., favored the growth of southerly plants in more northerly regions. According to Sauer (1965), the present day floristic associations of North America were displaced northward several hundred miles during the height of that period. During the past 600 years, however, there has been a gradual lowering of world temperatures, and this has resulted in the southward contraction of the range of many species (Ugent et al, 1981).

Utilizing the above information then, it is possible to reconstruct at least a partial history of the past migrations of the river bluff species, D. amethystinum. As would seem the case with the vast majority of midwestern plants, this species was probably limited in its distribution to areas well south of the glacial limits during the four major ice advances of the Pleistocene. Survival in the driftless area of the upper midwest may have been restricted to species of the arctic tundra, or, at best, to the more hardier species of the boreal forest. Northern river-bluff plants, or species with close relatives in the Missouri Ozarks (as for example D. amethystinum and its prairie-woodland counterpart, D. meadia), probably merely migrated south along the ridge tops of the Mississippi River or its embayment. Later, with the return of warm, humid conditions, these plants migrated northwards beyond their present day limits; returning only after the onset of the current worldwide temperature trend toward cooler weather.

LITERATURE CITED

Dolf, E. 1960. Climatic changes of the past and present. Am. Sci. 48(3):341-364.

Fassett, N.C. 1927. Notes from the herbarium of the University of Wisconsin I. Rhodora 29:233.

______ . 1929. Notes from the herbarium of the University of Wisconsin IV. Rhodora 21:52.

______ . 1931. Notes from the herbarium of the University of Wisconsin VII. Rhodora 33:224-228.

______ . 1944. Dodecatheon in eastern North America. Am. Midl. Nat. 13:455-486.

Fernald, M.L. 1925. Persistence of plants in unglaciated areas of Boreal America. Mem. Am. Acad. Arts & Sci. 15:317.

______ . 1950. "Gray's Manual of Botany." Ed. 8. Am. Book Co., N.Y.

Iltis, H.H. and W.M. Shaughnessy. 1960. Preliminary reports on the flora of Wisconsin No. 43. Primulaceae-primrose family. Trans. Wis. Acad. Sci., Arts & Letters 49: 113-135.

Jones, G.N. 1950. "Flora of Illinois." Ed. 2. Univ. of Notre Dame Press, Notre Dame. 368 pp.

Mohlenbrock, R.H. 1978. "The Illustrated Flora of Illinois: Flowering Plants, Hollies to Loasas." Southern Illinois University Press, Carbondale.

Sauer, C.O. 1965. "Land and Life." Ed. John Leighly, Univ. of Calif. Press, Berkeley and Los Angeles, 435 pp.

Spurr, S.H. 1964. "Forest Ecology." The Ronald Press, N.Y., 352 pp.

Steyermark, J.A. 1940. Dodecatheon amethystinum Fassett. Rhodora 42:107.

______ . 1963. "Flora of Missouri." Iowa State University Press, Ames.

Strausbaugh, P.D. and E.L. Core. 1958. "Flora of West Virginia (Part III)." W. Virginia Bull. Series 58, No. 12-3.

Thompson, H.J. 1953. The biosystematics of Dodecatheon in eastern North America. Contr. Dudley Herb. 4:73-154.

Ugent, D., Tindall, D.R. and N.J. Doorenbos. 1981. Big trees of the southern Illinois Cache River bottoms. Phytologia 47(5):420-440.

Wherry, E.T. 1943. Dodecatheon amethystinum. Bull. Am. Rock Gard. Soc. 1:91-94.

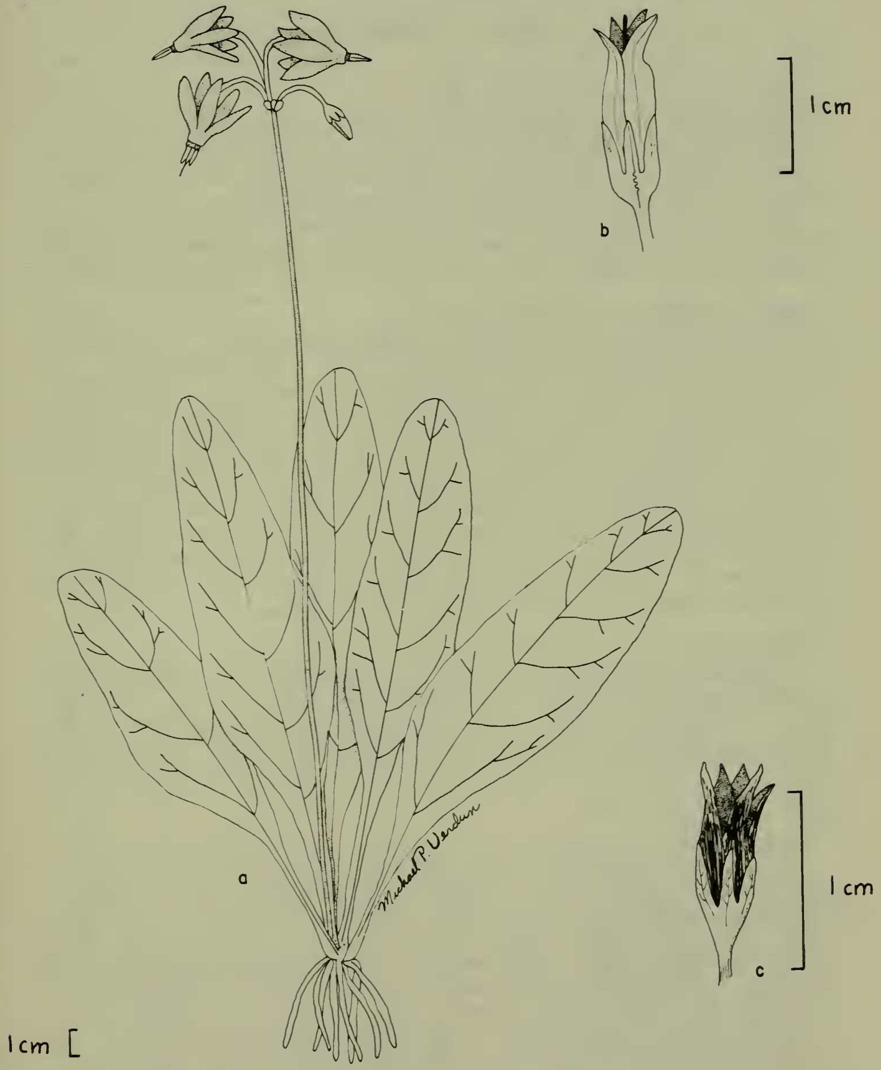

Fig. 1. Dodecatheon amethystinum from Cave Springs Hollow, Calhoun Co., Illinois (Ugent, Mibb & Verdun 23, 115. SIU). a. Habit. b. Capsule. c. Capsule of D. media.